Escape Responses of Three Indian Molluscs

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INTRODUCTION

The marine molluscs exhibit a wide range of defensive responses to predators, including a variety of active muscular reactions, often leading to flight by an accelerated normal locomotory gait or by some mode of locomotion not normally employed. In recent reviews of these responses Feder & Christensen (1966) and Ansell (1969a) have brought together a synopsis of many scattered references to this phenomenon which clearly indicate that specific responses are characteristic of certain families or groups of families indicating a common and presumably ancient origin for the response. Certain groups of the bivalves and gastropods thus apparently possess the potentiality to respond to potential predators, and representatives of these groups from different geographical areas or habitats may also be expected to exhibit similar responses. This is the case in the records presented here, which are of interest since they relate to molluscs from the tropics, while most of the previous records refer to species from temperate seas. The responses were observed in the laboratory, in small aquaria, either at the Biological Oceanography Division of the Indian National Institute of Oceanography, Ernakulam, South India, or at the Centre for Advanced Studies in Marine Biology, Porto Novo.

OBSERVATIONS

Mactra olorina Philippi, 1846

(Bivalvia, Eulamellibranchia, Mactridae)

This species of *Mactra,* collected from sand near low water from a beach near Shertallai, some 20 miles south of Ernakulam, exhibited the typical bivalve leaping response when contacted on the siphon or mantle margins by the foot of the predaceous gastropod *Oliva gibbosa* (Born, 1778). The leaping response which occurred from either the buried position or from the surface of the sand was essentially the same as that described for the temperate mactrid, *Mactra corallina* (Linnaeus, 1758) (Ansell, 1969b). Repeated stimulation resulted after a short time in a failure of the bivalve to respond by leaping, although there was an increase in shell gape, a reaction which together with the extension of the siphons to their full length always occurs before leaping. The leaping movements need not be described here since they show no special features different from those of *Mactra corallina.*

Oliva gibbosa and *Mactra olorina* were both collected from the beach at Shertallai, during January, 1968. The general adaptations of these species to life on a surf-washed tropical beach will be described elsewhere, but *M. olorina* is a fast burrowing active form whose normal buried position is with the dorsal shell margins just covered by the sand, while *O. gibbosa* is an active predator, moving through or over the sand by means of a large foot. At Shertallai, *Oliva* was found near high water mark at low tide, and only during January of the period January to April, although it is not known whether its disappearance later was caused by migration offshore, or by local predation by the fishing community along the shore, who utilize all types of shellfish food. Probably both play a part, for Crichton (1942) records that on the east coast of India near Madras, *O. gibbosa* is to be found on the shore for a brief season only, early in February each year. The feeding habits of the Olividae are not well known. Members of the family are common in the faunas of sand beaches in the tropics and warm temperate zones, and it may be expected that they will be found to elicit escape responses from molluscs and other invertebrates from such habitats. At Shertallai, other molluscs collected from the sand included *Donax incarnatus* Gmelin, 1791; the venerid *Timoclea imbricata* (J. de C. Sowerby, 1826), *Sunetta solanderii* (Gray, 1821) and the gastropod *Bullia melanoides* (Deshayes, 1832). None of these showed any response to *O. gibbosa,* but of these *Donax* and *Bullia* are extremely active forms which exhibit tidal migrations and hence any further specific response to predators is probably unnecessary. The food of *Oliva* at Shertallai could not be determined, but may include some *Donax* which have been stranded by the receding tide, since such stranded *Donax* and *Oliva* both occurred in a narrow zone near the high water mark.

Umbonium vestiarium (Linnaeus, 1758)

(Gastropoda, Prosobranchia, Trochidae)

The response of *Umbonium,* which was observed at Porto Novo, was observed in an aquarium in which *Umbonium* was present together with the carnivorous gastropod *Bursa spinosa* (Lamarck, 1816). These two species are not normally sympatric, and so these observations merely indicate the ability of *Umbonium* to perform escape responses, but do not indicate the predator which normally evokes such responses. *Umbonium* responds by performing a series of rolling movements produced by the action of the foot which twists from side to side to push against the substratum after the animal has rolled over to lie on the shell with the foot extended into the water. The movements are essentially similar to those performed by some members of the Trochidae, and especially *Calliostoma zizyphinum* (Linnaeus, 1758) (Feder, 1967; Ansell, 1969a), in response to contact with certain asteroid starfish.

Umbonium is a common species on the surf-washed sandy beaches near Porto Novo, and shows interesting modifications of the basic trochid structure which enable it to exploit this habitat. In the aquarium it exhibits considerable activity, and movements of the same type as the escape response occur apparently spontaneously. It is likely that similar movements are used in active movement on the shore, perhaps as in some bivalves representing a response to lack of suitable substrata for burrowing (Ansell, 1969b) or, as in the stenoglossan gastropod *Bullia melanoides,* contributing to a complex behavioural pattern by which the animal migrates up and down the shore with each tidal cycle. In the aquarium similar movements to those of the escape response also occur when one *Umbonium* touches another while crawling and similar intra-specific reactions were also noted for *Bullia melanoides* from Shertallai Beach.

Babylonia spirata (Linnaeus, 1758)

(Gastropoda, Prosobranchia, Buccinidae)

The conditions under which the response of *Babylonia* was observed were also artificial and probably in no way represent a normal provocation. The specimen of *Babylonia* had been placed for observation in a large glass vessel which already contained a single individual of the volutacean *Harpa conoidalis* Lamarck, 1822 and 2 *Bursa spinosa.* After a short time the *Bursa* attacked the *Harpa,* which retracted when pierced by the proboscis of the *Bursa* and produced a copious secretion of mucus. The *Bursa* was disturbed and withdrew the proboscis, and during this disturbance the response of the *Babylonia,* which was nearby, was observed. The response consisted of the animal turning so that it lay on the side of the shell with the foot extended in the water. A series of rolling/leaping movements followed caused by a vigorous rotation of the foot to press against the substrata first on one side and then the other so that the shell is moved actively over the surface in a zig-zag course. These movements are produced in the same way as, and are similar in essentials to, the escape responses of the temperate buccinid *Buccinum undatum* Linnaeus, 1758 or of members of the family Nassidae (Feder, 1967). It is possible that some secretion from the withdrawn proboscis was responsible for eliciting the response.

DISCUSSION

These three examples of defensive responses by molluscs from India present further evidence for the occurrence of similar responses within certain groups of molluscs. Thus the two gastropod groups represented, the Buccinacea and the Trochacea, together with the Zeugobranchia and Patellacea, comprise a majority of the previous records of locomotory responses by marine gastropods (Ansell, 1969a). The members of the latter three groups are almost exclusively inhabitants of rocky shores, and it is therefore of considerable interest to find exactly similar responses exhibited by a species which has become adapted to life in the disturbed environment of a tropical surf-washed sand beach. Responses of this kind are apparently of as much significance in the community relationships of sand dwelling forms as they are in those of rocky shores, which have provided most of the earlier examples.

This view receives support from the occurrence of a response in the sandy-shore bivalve *Mactra olorina.* In addition, this reaction is interesting since, although several examples have been described of reactions by herbivorous gastropods to the presence of, or contact with, carnivorous gastropods, most previous records of leaping responses by bivalves are of responses to asteroid starfish, the only exceptions of which I am aware being these of *Ensis directus* (Conrad, 1843) which Turner (1955) described as emerging from the sand in response to an attack by the predaceous snail *Polinices duplicata* (Say, 1822) and the reactions of *Mactra* sp. to *Natica millepunctata* Lamarck, 1822 and *N. hebraea* and *Spisula solida* (Linnaeus, 1758) to *Lunatia nitida* (Donovan, 1803) described by Hirsch (1915) and Ziegelmeier (1954) respectively. There are no previous records of a member of the Olividae being responsible for eliciting escape responses in other invertebrates.

These three examples in part extend our knowledge of defensive responses to a tropical fauna. The great variety of species in tropical faunas and the resultant complexity of the communities suggest strongly that such responses may play an even more important role in community interrelationships in the tropics than they do in temperate waters. The numerical superiority of records of such responses from temperate forms probably reflects no more than the greater opportunities at present available for collection and observation of marine molluscs in temperate regions.

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